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ABSTRACT

This is the second of four reports of the Interactive Group Modeling project--an undertaking designed to extend group communication through computers to support the more task-focused communication required by those building computer models. The report focuses on the HUB system--a system that facilitates communication in four modes: computer conferences, shared visual spaces, program workspaces, and document workspaces. Specifically, the report introduces the concept of interactive monitoring of group communication and explores the uses and impacts of the HUB monitor. (FL)

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INTERACTIVE GROUP MODELING:

PART 2. AN INTERACTIVE MONITOR

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This report is the second in the *Interactive Group Modeling* series. The other reports are:

Part 1. *Extending Group Communication through Computers* by Hubert Lipinski, Robert Plummer, and Kathleen Spangler Vian, Report R-44

Part 3. *HUB and the Modeling Process* by Kathleen Spangler Vian, Hubert Lipinski, Sara Spang, and John Tydeman, Report R-46

Part 4. *Some Preliminary Tests of the HUB System* by Sara Spang, Barbara McNeal, and Kathleen Spangler Vian, Report R-47

The HUB User Guide, a manual for users of the HUB system

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Interactive Monitoring: The Concept

Group communication is always under surveillance.

Not by a sleuth in a trench coat. Not by some hidden electronic eye.

Rather, group communication is always under surveillance by the group members themselves. They sense their own participation and that of others. They watch the level of interest in the task at hand. They note the growth and decline of the discussion. And they modify their own behavior accordingly.

They do this privately. Intuitively. Almost unconsciously at times. But the effectiveness of the group often depends on how well its members monitor their own communication. Misperceptions and differing perceptions of the group's process can create misunderstandings and conflict--or at least personal discomfort. Thus, people who assist in conflict resolution or who serve as organizational consultants typically try to increase awareness of communication patterns. They try to make the private, intuitive monitoring of group communication more public and more systematic.

In computer-based group communication, the computer can play the role of a "process consultant." Since a computer conferencing program acts as a kind of gatekeeper for the communication process--directing participants to appropriate "activities" and ordering their "messages"--it can easily be extended to record important features of the group's communication patterns.

Computer monitoring of group communication has, in fact, already been demonstrated with the PLANET system.* PLANET includes software that collects and analyzes information about the time users enter and leave a PLANET

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*See Jacques Vallee et al., *Group Communication through Computers, Volumes 3 and 4*, Institute for the Future, Reports R-39 and R-40, 1975 and 1977; and Robert Johansen et al., *Group Communication through Computers, Volume 5*, Institute for the Future, Report R-41, 1977.

activity, the number of public and private messages sent, the number of words in public and private messages, the use of commands, the typing time, and the number of computer resource units used, among other statistics. This information has been used by the developers of the system to evaluate the impact of the medium on group communication. It has revealed several different styles of computer conferencing among users of the system.

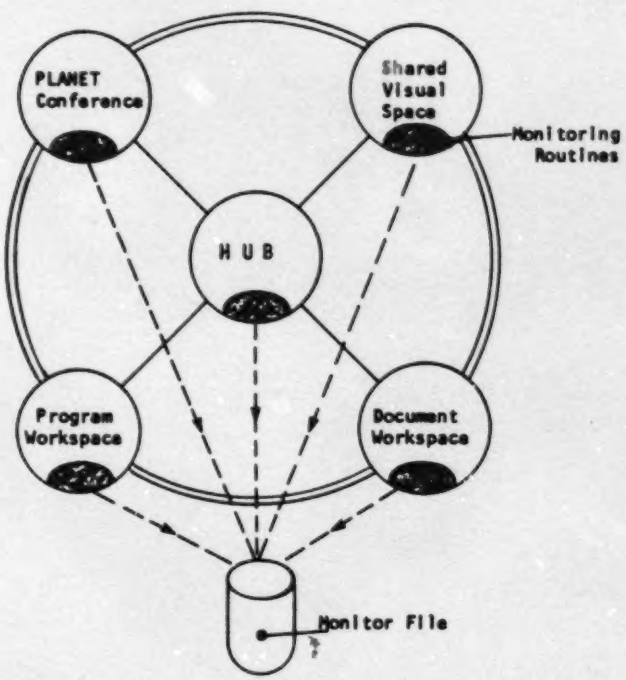
The information from the PLANET monitor was never made available to participants during their discussions in PLANET conferences. However, there is no technical reason why such information could not be made available during a computer conference. It could then serve as a consultant about the group communication process, increasing the group's consciousness of its communication patterns and thereby giving them more control over those patterns.

In designing the HUB system to support interactive group modeling, we have developed a monitor to assist in our evaluation. As part of the HUB monitor, we are developing an interactive display that users will be able to call on at any time to analyze their own individual patterns or those of the entire group. This report describes the HUB monitor, the interactive display, and the possible uses and impacts of the interactive display.

The HUB Monitor

The HUB monitor is designed to collect information about communication patterns in PLANET and in the workspaces as well as information about the movement among these activities, as illustrated in Figure 1.*

FIGURE 1
DATA COLLECTION IN THE HUB MONITOR



*We hope to implement the shared visual space early in 1980.

One of the central questions in designing the monitor is: What should be monitored? There are a variety of ways of viewing the group process, and each view suggests different data requirements. For example, our previous work with the PLANET program established a taxonomy of group communication through electronic media that included four categories of processes: group, individual, task, and medium. Another view might include functional categories, such as Parsons' Four Functions (adaptation, goal attainment, integration, and latent pattern maintenance).* Still another view might be developmental; numerous authors have outlined developmental phases in groups.**

While we have designed the HUB monitor to collect usage statistics that could be used in all of these types of analyses, we have been guided by a scheme that includes three basic categories: networks of participants, participation of group members, and use of system features. The statistics collected directly by the HUB monitor are listed in the appendix to this report.

NETWORKS OF PARTICIPANTS

Communication networks reveal the flow of information between individuals in a group. They also provide an information map of the group as a whole. Furthermore, if these networks are captured at different points in time, they can depict the development of the group and the flow of information over time.

Networks typically consist of *nodes* and *links*. Normally, nodes are thought to be people, but they may also include automated information systems or libraries or even computer programs. Links are the communication channels between nodes. Together, the nodes and links form a pattern that is called the *structure* of the network.

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*See summary in A. Paul Hare, *Handbook of Small Group Research*, New York: The Free Press, 1976.

**In Part 4 of this report, we include a developmental analysis of three preliminary tests of the HUB system.

A variety of concepts has evolved to describe these three features of networks. These include such descriptors of the network as range, connectedness, openness, reachability, strength, multistrandedness, and symmetry. The HUB monitor collects or calculates these as follows:

- *Range* is the total number of members in the network. In some cases, this number will be arbitrarily defined by the number of participants listed in an activity. However, if an individual is registered in more than one activity or if the network is calculated for a specific period of time, the range can vary.

- *Strength* of a network link is generally defined as the frequency and/or duration of communication. Since we are dealing with group communication in which all participants potentially have access to all communication, we have added as a criterion: the *age of information*, or the length of time between an entry and its review. For example, the strength of links of a network in a program workspace is a combined measure of

  - number of times A observes B's program runs
  - number of times B observes A's program runs
  - number of times A comments on B's program runs
  - number of times B comments on A's program runs
  - number of times A reviews B's program runs
  - number of times B reviews A's program runs
  - the average length of time between A's program run and B's review of the run, etc.

- *Symmetry* of a link is derived from the strength of the link in both directions.

- *Connectedness* is typically a measure of the number of direct links in a network compared to the total possible direct links; it is one description of the nature of the network.

- *Reachability* of a node is related to connectedness but describes the accessibility of the individual in the network; it is calculated by the number of steps required for any other member to reach that node.

- *Openness* is a measure of the number of links to other networks and may be important if several group members are participants in several activities.
- *Multistrandedness* is not amenable to measurement by the monitor at present.

The monitor currently provides network information in tabular or matrix form. We hope eventually to develop graphic displays of some of this information.

PARTICIPATION OF GROUP MEMBERS

Participation patterns can offer insights into group leadership, productivity, and availability of resources to the group. They can also reveal subgroups who may have unique communication needs or unique problems in communicating with the larger group. Two types of participation patterns interest us in particular.

The first is participation rank. Each participant is ranked in descending order, based on his or her contribution to the total volume of information. In a PLANET conference, the rankings are determined by percent of total messages, as well as percent of public messages and percent of private messages. In the program workspace, these rankings can be calculated by the monitor from the percent of program runs initiated, as well as percent of total comments. In the document workspace, participants can be ranked according to their percentage of total number of changes to the document and total comments. Finally, since the HUB monitor is designed to track the age of information at the time it is received, it is possible to rank the participants in terms of the "timeliness" of their participation in any of the HUB activities.

The participation map portrays a second type of participation pattern. This map compares participation in one type of activity with participation in another. For example, in a PLANET conference, a participation map can compare public vs. private message sending. In a program workspace, the comparison might be between lines of program run and lines of program

observed. Such comparisons suggest types of subgroups in an activity--private vs. public communicators, for example, or "runners" vs. "observers."

USE OF FEATURES

The network and participation data focus on group interaction; the monitor also collects data about the use of system features over time. These data not only give us, as designers, some insight into the usefulness of various features; they also indicate the relative role of various parts and features in the communication process.

For example, the monitor captures the following information, for both individuals and the group as a whole, over time:

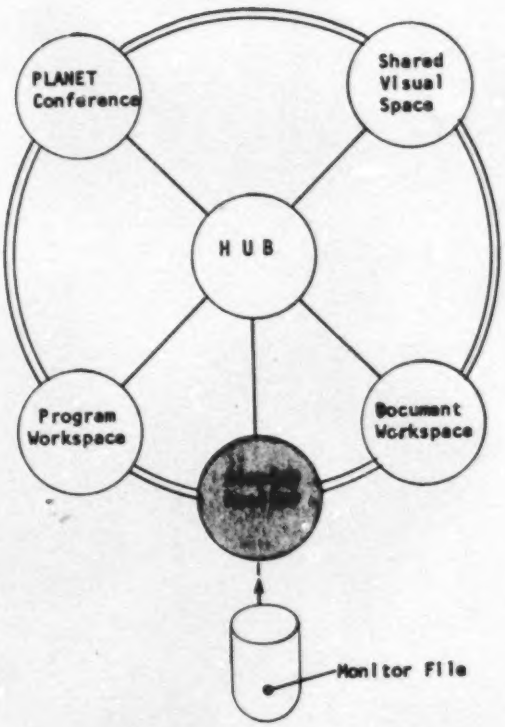
- the time spent in PLANET conferences, program workspaces, and document workspaces
- the amount of time spent in specific HUB activities
- the use of all the principal services--public and private messages in PLANET; RUN, COMMENT, and REVIEW services in the program workspace; and EDIT, REVIEW, PRINT, AND COMMENT services in the document workspace
- the use of general HUB services, such as the SAVE and SUBMIT features, the ADD (participant) feature, etc.

When compared with the network and participation patterns, these system use patterns begin to suggest the impact of the HUB system itself on the group process. We will explore some possible impacts on communication in the last chapter.

The Interactive Display Monitor

The interactive display monitor will use the HUB monitor to make some of the data available to participants in HUB activities *during their participation*. It will become, in effect, another activity in the HUB cluster of activities (see Figure 2).

FIGURE 2
THE INTERACTIVE DISPLAY MONITOR



In implementing the interactive display monitor, we face a number of choices. First are questions of which patterns to display. It is easy to imagine more than a hundred graphs and tables developed from the statistics being gathered. And even the patterns listed in the previous chapter may be too detailed for the users of the HUB system.

Second are choices about the representation of information about those patterns selected for display. Third are choices about the users' interaction with the monitor: Should they automatically get a display of a dozen or so preset graphs and tables or should they be able to specify what they want to see and in what form? And if they specify what they want to see, how do they know what they *can* display?

We are taking an intermediate path in answering these questions. We have selected a small number of types of displays that users will be able to request in a variety of permutations. These basic types correspond to our three categories of network, participation, and use-of-features patterns. When possible, they will be displayed graphically. However, as noted earlier, the network patterns are currently presented in tabular form.

To use the interactive display monitor, a HUB user types the JOIN command, followed by the word MONITOR. (This is the standard way of joining any HUB activity.) HUB then starts the interactive monitor as follows:

```
↑P
- Join (activity) Monitor↵

The following are the principal patterns available to you:
  Network(of participants)
  Participation(of participants)
  Use(of system features)

Please indicate the pattern you wish to display:
-
```

If the user simply types NETWORK, the monitor will display the network of all participants in all activities in which that user is a member. The network will be displayed in matrix form; the numbers in the matrix indicate the strength of the link on a scale from 1 to 10. (This scale is a composite of the statistics indicated for network strength in the previous section.) It will also list figures for range and connectedness of the network.

For example:

Please indicate the pattern you wish to display:
- Network(of participants)

NETWORK FOR: ALL ACTIVITIES

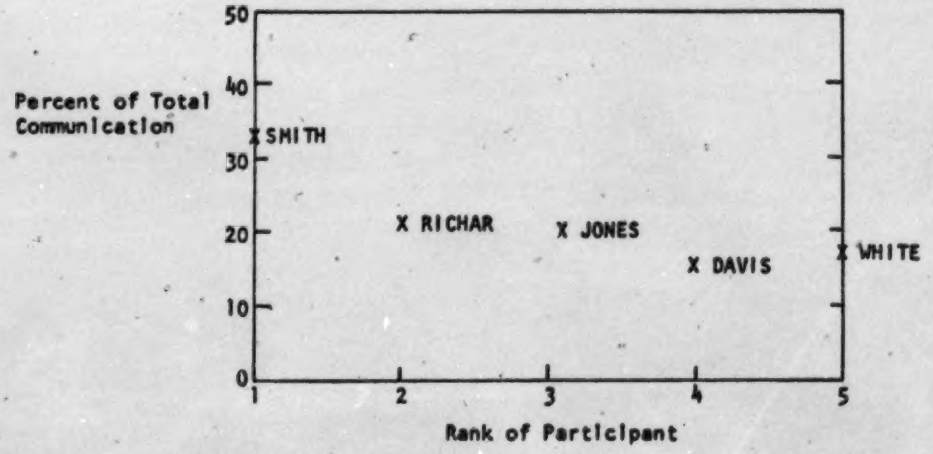
	TO:	SMITH	JONES	WHITE	RICHAR	DAVIS
FROM:	SMITH	0	10	6	9	4
	JONES	7	0	2	9	1
	WHITE	1	1	0	3	3
	RICHAR	6	8	3	0	3
	DAVIS	3	2	4	1	0

Range = 5
Connectedness = .79

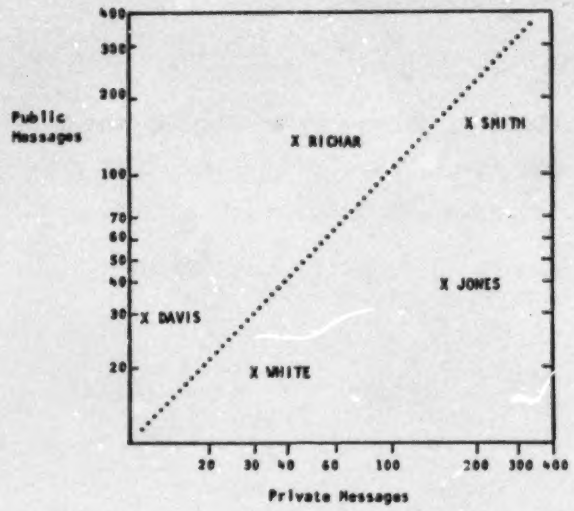
A request for participation patterns will produce four graphs. The first is a combined participation ranking for all activities in which the user is a member. This is followed by three participation maps, one each for PLANET conferences, program workspaces, and document workspaces. For example:

Please indicate the pattern you wish to display:
- Participation(of participants)

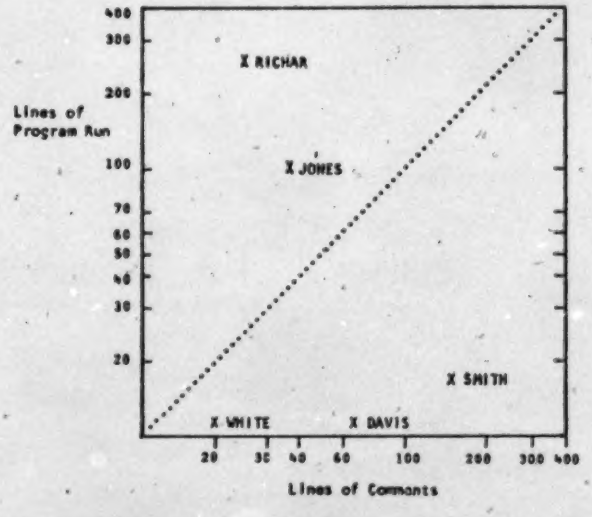
PARTICIPATION RANK FOR: ALL ACTIVITIES



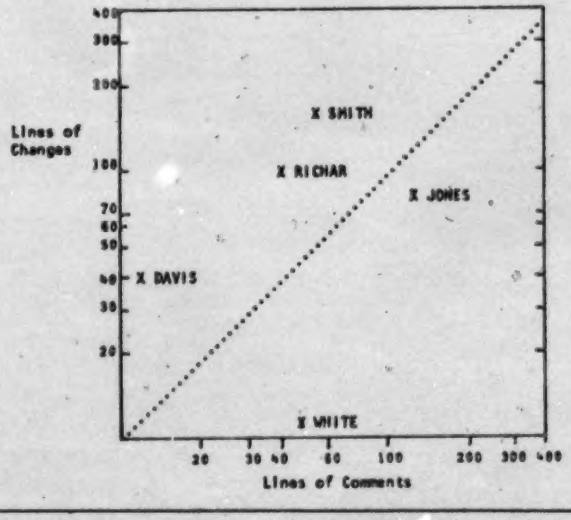
PARTICIPATION MAP FOR:
ALL PLANET CONFERENCES



PARTICIPATION MAP FOR:
ALL PROGRAM WORKSPACES

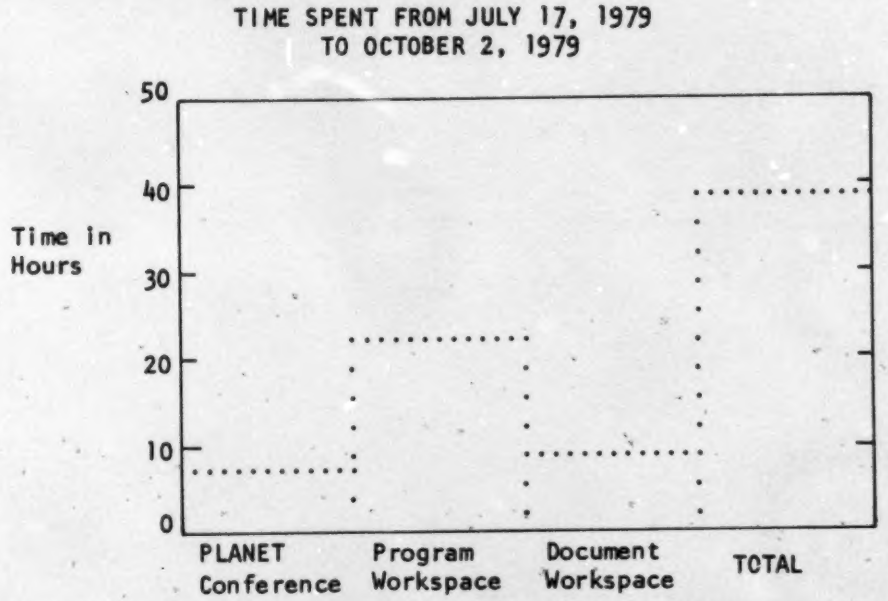


PARTICIPATION MAP FOR:
ALL DOCUMENT WORKSPACES



Finally, a request to display the use of system features will produce a single graph, showing the amount of time spent by all members of all activities in which the user is registered, as follows:

Please indicate the pattern you wish to display:
- Use(of system features)



Obviously, these aggregate charts may not always provide information needed by a group or individual. Thus, users will be able to further specify which patterns they wish to display by using the following restrictions with any of the patterns:

FOR ACTIVITIES and a list of activity numbers

FOR PARTICIPANTS and a list of participants' names

BEFORE, ON, OR AFTER a date such as 17-MAY-79

BETWEEN a date AND another date

PUBLIC MESSAGES

PRIVATE MESSAGES

RUNS

COMMENTS

EDITS

REVIEWS

CHANGES

We have designed the interactive monitor in the absence of any previous experience with such a process, so we can expect that some of the display procedures may prove more useful than others. Also, there are probably a number of creative ways to display the information that would speak directly to problems that plague particular users. For instance, referring to people by some label other than their names could provide some interesting insights. If a graph showing distribution of participation in an interdisciplinary group were labeled by disciplines rather than names, it might become clear, for example, that subgroups were developing along disciplinary lines. The group could then assess whether this pattern were appropriate for the phase of the activity or whether some important insights were being lost due to lack of effective communication between the subgroups. As we test the monitor design over the next two years, we will want to experiment with these features and possibly revise the design accordingly.

The Impact on Communication

An interactive monitor in HUB is bound to increase the user groups' awareness of their communication patterns. Our hope, in designing such a monitor, is that this increased awareness will provide opportunities for improved communication through the HUB system. However, it is also possible that the awareness of communication patterns may get in the way of communication at times. Over the next two years, we plan to test the HUB system and interactive monitor in a field setting. Through this testing, we hope to identify both positive and negative impacts; for now, we can only speculate about possible impacts.

For example, one possible effect is that a new role will develop in the communication process, that of group facilitator. We have already noted the tendency for such a role to develop in PLANET conferencing.* In a HUB activity, this role might include responsibility for checking the monitor regularly and interpreting the results for the group. The facilitator might use the private message mode to counsel individual group members about their participation patterns or might use the displays in group sessions to consider the implications of the patterns for complaints or difficulties that the group may be experiencing.

A second possible effect of the monitor would be to encourage more experimentation with group structures. As the group becomes more conscious of its communication patterns, it may wish to intervene in these patterns by tinkering with roles and responsibilities and then following the monitor to observe the effects of the experimentation.

It seems very likely that such a monitor could and would be used to evaluate performances of individual members of the group. Certainly, it

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*See Jacques Vallee et al., *Group Communication through Computers, Volume 4*, Institute for the Future, Report R-40, 1977.

would make an individual's contribution to the group more apparent; it might also provide a reading on the more elusive measures of performances, such as ability to get along with one's colleagues. Such an evaluation tool may indeed seem attractive to someone who is faced with objectively evaluating a group of people; however, we see real dangers as well. First, there is the possibility that the very existence of the monitor will inhibit some communication, and it may actually discourage the participation of some people altogether. Also, the monitor may encourage some people to "perform," to alter their behavior just to show up well in the monitor data. Finally, the use of the monitor could encourage evaluation of the *wrong* aspects of performance, particularly if the data that are easily collected are not the best data for evaluation.

These speculations, then, can serve as a starting point for testing the HUB system in the next two years. We hope to do these tests with a wide range of groups who have diverse tasks and differing amounts of experience with computer-based communication. We certainly encourage inquiries from any groups who would, themselves, like to experiment with an interactive monitor.

Appendix: Technical Specifications of the HUB Monitor

The HUB system monitor has been implemented both in the HUB module itself and within each of its submodules. The monitor within the HUB module collects data describing an individual's use of the constituent submodules. The monitoring routines within the submodules supply data on the particular functions and services each provides. For each account (every user group would ordinarily have a separate account), the usage data collected by the monitoring routines in the HUB module and the individual submodules are channeled into the same computer file (see Figure 1, page 3). This common storage of usage data greatly facilitates the processing and subsequent display of usage statistics.

As indicated, the HUB system monitor writes two types of records: the HUB module monitor record provides an overview of what a participant does in the HUB system; the submodule monitors collect more detailed information about the participant's usage. The monitor record for the HUB module is a fixed length record whose data include: the participant's name, the date and time he or she entered HUB, the number of activities joined (by type of activity), the time spent, and CPU time used in each activity. This record is initially written to the file when the participant enters HUB and is updated whenever he or she finishes an activity or leaves the HUB system. The format and description of the record is given in Table 1 on page 21.

Each of the individual submodules collects data through a similar procedure. At the beginning of each record, there is a main block, which provides information on the type of submodule, the name of the participant and activity, when it was entered, and how long it was used. Following this main block are subblocks that document the principal services the participant uses. These are appended to the main block in the order the services are requested. Thus, each of the submodule monitor records is of variable length and as such is only written to the monitor file when a participant leaves

the activity supported by the submodule. The data recorded by the main and subblocks are shown in Tables 2-12.

To reduce the cost of file storage, the monitor records are written in binary form. Also since many participants or processes may be writing into the file simultaneously, special protocols to prevent interference are designed into the structure of the records and monitor software. Thus, the length of each record (and constituent subblocks) is recorded in its first word. This permits the reading and writing subroutines in the monitor to determine its length as well as to find the location of the next record. In addition, these subroutines are coded in assembly language so that many processes can share the file for both reading and writing purposes.

TABLE 1

HUB MONITOR: RECORD

Word #	Bits	Description
0	0-8	Module identifier (=1)
	9-26	Not used
	27-35	Number of words in record (=7)
1	0-17	Date of entry in internal date format
	18-35	Time of entry in seconds since midnight
2	0-5	First character of participant name in sixbit
	.	.
	.	.
	.	.
	30-35	Sixth character (if none, then it is null)
3	0-5	Number of activities entered
	6-20	Total time in HUB system in seconds
	21-35	Total CPU time used in HUB system in tenths of seconds
4	0-5	Number of PLANET activities entered
	6-20	Total time in PLANET activities in seconds
	21-35	Total CPU time used in PLANET activities in tenths of seconds
5	0-35	Same format as in word 4 but for Program Workspace activities
6	0-35	Same format as in word 4 but for Document Workspace activities

TABLE 2

PLANET CONFERENCE: MAIN MONITOR BLOCK

Word #	Bits	Description
0	0-8	Module identifier (=10)
	9-17	Number of participants whose public messages were seen
	18-26	Number of participants whose private messages were seen
	27-35	Number of words in record
1	0-35	Date and time of entry
2	0-35	First 6 characters in participant name
3	0-5	Number of services requested
	6-20	Time spent in conference in seconds
	21-35	CPU time used in tenths of seconds
4	0-35	First 6 characters in activity name
5	0-7	Number of public messages seen
	8-17	Number of lines in messages
	18-35	Average age of messages in minutes
6	0-7	Number of private messages seen
	8-17	Number of lines in messages
	18-35	Average age of messages in minutes
7	0-7	Number of public messages made
	8-17	Number of lines in messages
	18-35	Time typing in seconds
8	0-7	Number of private messages made
	8-17	Number of lines in messages
	18-35	Time typing in seconds
9	0-35	Name of participant(s) whose public messages were seen
10	0-35	Name of participant(s) whose private messages were seen

TABLE 3

PLANET CONFERENCE: REVIEW SERVICE SUBBLOCK

Word #	Bits	Description
0	0-8	Module identifier (=11)
	9	If set reviewed by participant name
	10	If set reviewed by date
	11	If set reviewed by keyword
	12	If set reviewed by number
	13-17	Not used
	18-26	Number of participants whose messages were reviewed
	27-35	Number of words in subblock
1	0-11	Time started in seconds since entry
	12-23	Duration of review in seconds
	24-35	CPU time used in tenths of seconds
2	0-7	Number of messages reviewed
	8-17	Number of lines in messages
	18-35	Average age of messages in minutes
3	0-35	Name of participant(s) reviewed

TABLE 4

PROGRAM WORKSPACE: MAIN BLOCK

Word #	Bits	Description
0	0-8	Module identifier (=20)
	9-26	Not used
	27-35	Number of words in record
1	0-35	Date and time of entry
2	0-35	First 6 characters in participant name
3	0-5	Number of services requested
	6-20	Time spent in workspace in seconds
	21-35	CPU time used in tenths of seconds
4	0-35	First 6 characters in activity name

TABLE 5

PROGRAM WORKSPACE: RUN SERVICE SUBBLOCK

Word #	Bits	Description
0	0-8	Subblock identifier (=21)
	9-17	Run number
	18-26	Number of participants whose comments were seen
	27-35	Number of words in subblock
1	0-11	Time started in seconds since entry
	12-23	Duration of run in seconds
	24-35	CPU time used in tenths of seconds
2	0-35	First 6 characters in program name
3	0-11	Lines in program interaction
	12-23	Lines input to program
	24-35	Lines of transcript stored
4	0-5	Number of suspensions
	6-20	Time in suspension in seconds
	21-35	Time typing comments in seconds
5	0-7	Number of comments seen
	8-17	Number of lines in comments seen
	18-25	Number of comments made
	26-35	Number of lines in comments made
6	0-35	Name of participant(s) whose comments were seen

TABLE 6

PROGRAM WORKSPACE: COMMENT (OBSERVE) SERVICE SUBBLOCK

Word #	Bits	Description
0	0-8	Subblock identifier (=22)
	9-17	Run number
	18-26	Number of participants whose comments were seen
	27-35	Number of words in subblock
1	0-11	Time started in seconds since entry
	12-23	Duration of commenting in seconds
	24-35	CPU time used in tenths of seconds
2	0-35	First 6 characters in program name
3	0-7	Not used
	8-17	Number of lines in program transcript seen
	18-35	Average age of transcript in minutes
4	0-7	Number of comments seen
	8-17	Number of lines in comments
	18-35	Average age of comments in minutes
5	0-7	Number of comments made
	8-17	Number of lines in comments
	18-35	Time typing in seconds
6	0-35	Name of participant(s) whose comments were seen

TABLE 7

PROGRAM WORKSPACE: REVIEW SERVICE SUBBLOCK

Word #	Bits	Description
0	0-8	Subblock identifier (=23)
	9	If set reviewed by participant name
	10	If set reviewed by date
	11	If set reviewed by keyword
	12	If set reviewed by number
	13	If set reviewed with no comments
	14	If set reviewed with comments only
	15-17	Not used
	18-26	Number of participants reviewed
	27-35	Number of words in subblock
1	0-11	Time started in seconds since entry
	12-23	Duration of review in seconds
	24-35	CPU time used in tenths of seconds
2	0-35	First 6 characters in program name
3	0-7	Run number
	8-17	Number of lines in transcript seen
	18-35	Average age of transcript in minutes
4	0-7	Number of comments seen
	8-17	Number of lines in comments
	18-35	Average age of comments in minutes
5	0-35	Name of participant(s) reviewed

TABLE 8

DOCUMENT WORKSPACE: MAIN MONITOR BLOCK

Word #	Bits	Description
0	0-8	Module identifier (=30)
	9-17	Number of participants whose changes were seen
	18-26	Number of participants whose comments were seen
	27-35	Number of words in record
1	0-35	Date and time of entry
2	0-35	First 6 characters in participant name
3	0-5	Number of services requested
	6-20	Time spent in workspace in seconds
	21-35	CPU time used in tenths of seconds
4	0-35	First 6 characters in activity name
5	0-7	Number of changes seen
	8-17	Number of lines in changes seen
	18-35	Average age of changes in minutes
6	0-7	Number of comments seen
	8-17	Number of lines in comments
	18-35	Average age of comments in minutes
7	0-35	Name of participant(s) whose changes were seen
8	0-35	Name of participant(s) whose comments were seen

TABLE 9

DOCUMENT WORKSPACE: EDITING SERVICE SUBBLOCK

Word #	Bits	Description
0	0-8	Subblock identifier (=31)
	9-17	Edit number
	18-26	Number of participants whose comments were seen
	27-35	Number of words in subblock
1	0-11	Time started in seconds since entry
	12-23	Duration of editing in seconds
	24-35	CPU time used in tenths of seconds
2	0-35	First 6 characters in document name
3	0-5	Number of editing changes recorded
	6-17	Number of lines in editing transcript
	18-35	New length of document in lines
4	0-7	Number of deletions made
	8-17	Number of lines deleted
	18-25	Number of insertions made
	26-35	Number of lines inserted
5	0-8	Number of lines deleted in replace changes
	9-17	Number of lines inserted in replace entries
	18-25	Number of comments seen
	26-35	Number of lines in comments
6	0-5	Number of suspensions
	6-20	Time in suspension in seconds
	21-35	Lines input to editor
7	0-7	Number of nonreferencing comments made
	8-17	Number of lines in comments
	18-35	Time typing in seconds
8	0-7	Number of referencing comments
	8-17	Number of lines in comments
	18-35	Time typing in seconds
9	0-35	Name of participant(s) whose comments were seen

TABLE 10

DOCUMENT WORKSPACE: REVIEW SERVICE SUBBLOCK

Word #	Bits	Description
0	0-8	Subblock identifier (=32)
	9	If set reviewed by participant name
	10	If set reviewed by date
	11	If set reviewed by keyword
	12	If set reviewed by number
	13	If set reviewed with no comments
	14	If set reviewed with comments only
	15	If set reviewed by page
	16-17	Not used
	18-26	Number of participants reviewed
	27-35	Number of words in subblock
1	0-11	Time started in seconds since entry
	12-23	Duration of review in seconds
	24-35	CPU time used in tenths of seconds
2	0-7	Number of changes reviewed
	8-17	Number of lines in changes
	18-35	Average age of changes in minutes
3	0-7	Number of comments reviewed
	8-17	Number of lines in comments
	18-35	Average age of comments in minutes
4	0-35	Name of participant(s) reviewed

TABLE 11

DOCUMENT WORKSPACE: COMMENT SERVICE SUBBLOCK

Word #	Bits	Description
0	0-8	Subblock identifier (=33)
	9-17	Number of participants whose changes were seen
	18-26	Number of participants whose comments were seen
	27-35	Number of words in subblock
1	0-11	Time started in seconds since entry
	12-23	Duration of commenting in seconds
	24-35	CPU time used in tenths of seconds
2	0-7	Number of changes seen
	8-17	Number of lines in changes
	18-25	Number of comments seen
	26-35	Number of lines in comments
3	0-7	Number of nonreferencing comments made
	8-17	Number of lines in comments
	18-35	Time typing in seconds
4	0-7	Number of referencing comments made
	8-17	Number of lines in comments
	18-25	Time typing in seconds
5	0-35	Name of participant(s) whose changes were seen
6	0-35	Name of participant(s) whose comments were seen

TABLE 12

DOCUMENT WORKSPACE: PRINT SERVICE SUBBLOCK

Word #	Bits	Description
0	0-8	Subblock identifier (=34)
	9-17	Number of pages printed
	18-26	Not used
	27-35	Number of words in subblock (=2)
1	0-11	Time started in seconds since entry
	12-23	Duration of printing in seconds
	24-35	CPU time used in tenths of seconds